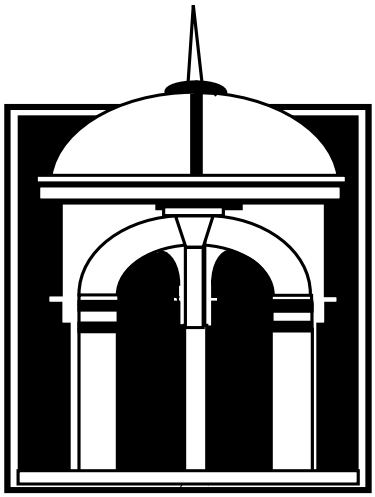

THE UNIVERSITY *of* TULSA

McDougall School of Petroleum Engineering

DRILLING RESEARCH PROJECTS
ADVISORY BOARD MEETING
November 5th, 2012

EXECUTIVE SUMMARIES

AGENDA

THE UNIVERSITY OF TULSA
Drilling Research Projects
Advisory Board Meeting

The DoubleTree Hotel at Warren Place
6110 S. Yale Avenue
Tulsa, OK 74136

AGENDA

Monday, November 5th, 2012

CLASSIC CONTINENTAL BREAKFAST……..7:45 a.m.
The DoubleTree Hotel at Warren Place
Tulsa Learning Theater

INTRODUCTION
Stefan Miska ……8:15 a.m. – 8:40 a.m.

PROGRESS REPORTS

Yahya Hashemian ……8:40 a.m. – 9:10 a.m.
Experimental Study and Modelling of Barite Sag in Annular Flow

Feifei Zhang ……9:10 a.m.- 9:40 a.m.
Investigation of Cuttings Transport in 30~60 Degree Inclined Wells

Ali Karimivajargah ……9:40 a.m.- 10:10 a.m.
Pressure Signature of Gas Influx

Coffee Break ……10:10 a.m.- 10:30 a.m.

Babak Akbari ……10:30 a.m.- 11:00 a.m.
PDC Drillbit Modeling and Experiments

Oney Erge …… 11:00 a.m.- 11:30 a.m.
Effect of Free Drillstring Rotation on Pressure Losses

Mojtaba Pordel Shahri……11:30 a.m.- 12:00 p.m.
Stress Path Analysis in Depleted Sands

LUNCH……12:00 p.m. - 1:15 p.m.
Parkview Ballroom

INDUSTRY PRESENTATION

Dale Jamison- Halliburton Technology Fellow.....1:15 p.m. – 1:45 p.m.
Modeling of Pressure Breaking in Gels

PROGRESS REPORTS

Zhaoyang Wang.....1:45 p.m.- 2:10 p.m.
Automatic Control of Drawworks

Bahri Kutlu ..... 2:10 p.m.- 2:40 p.m.
Rheology of Lightweight Drilling Fluids with Microsphere Additives

Hao Zeng ..... 2:40 p.m.-3:05 p.m.
Study of Effectiveness of LCM Materials

Coffee Break ..... 3:05 p.m.- 3:25 p.m.

RESEARCH PROPOSALS

Mehran Mehrabi .....3:25 p.m. - 3:40 p.m.
Comparison of Steel, Aluminium, Titanium, and Composite Drill Pipe

Sukru Durmaz.....3:40 p.m - 3:55 p.m.
Displacement and Mixing of Fluids in Pipe Flow

Reza Ettehadi Osgouei..... 3:55 p.m - 4:10 p.m.
Annular Pressure Build Up (APB) Analysis-Optimization of Fluid Rheology

NEW RESEARCH ASSOCIATE

Reza Ettehadi Osgouei .....4:10 p.m -4:25 p.m.
Review of Cuttings Transport

RESEARCH UPDATE- Mengjiao Yu .....4:25 p.m. – 4:45 p.m.

Shale Stability at Simulated Wellbore Conditions- Vahid Dokhani

Downhole Microchip Instrumentation System- Zhaorui Shi

Budget and Closing Comments .....4:45 p.m. – 5:00 p.m.

RECEPTION.....7:00 p.m – 9:00 p.m.
The DoubleTree Hotel at Warren Place – Parkview Ballroom
6110 S. Yale Avenue
Tulsa, OK 74136

THE UNIVERSITY OF TULSA
Advisory Board Meeting

University of Tulsa
2450 E Marshall
Tulsa, OK 74110

AGENDA

Tuesday, November 6th, 2012 NORTH CAMPUS

All Visitors Assemble in Drill Building Conference Room……9:00 a.m.

Nicholas Takach/ Evren Ozbayoglu……9:05 a.m. - 9:20 a.m.
Tour Schedule & Facility Improvements

FACILITY TOUR of NORTH CAMPUS.....9:20 a.m. – 11:00 a.m.

ROUND TABLE DISCUSSION……..11:00 a.m. – 11:30 a.m.

LUNCH…… 11:45 p.m.-1:00 p.m.
The University of Tulsa South Campus- Gallery

INDIVIDUAL MEETINGS (upon request**).**……1:30 p.m. – 5:00 p.m.

***********Next Advisory Board Meeting- May 13th and 14th , 2013************
Doubletree Warren Place Hotel- Tulsa

MEMBER COMPANIES

BP Exploration	**1977**
Petrobras/Cenpes	**1984**
Statoil	**1985**
Halliburton Energy Services	**1996**
Baker-Hughes	**1997**
Schlumberger	**1997**
Weatherford	**2000**
ExxonMobil	**2002**
ConocoPhillips	**2003**
Shell E&P	**2007**
National Oilwell Varco	**2007**
Bureau of Safety and Environmental Enforcement **(Formerly MMS)**	**2008**
ENI	**2008**
Det norske oljeselskap ASA	**2009**
Tesco	**2010**
Hess	**2011**
SINOPEC	**2011**
3-M	**2012**

TUDRP PERSONNEL

TUDRP PERSONNEL

EXECUTIVE DIRECTOR/ PRINCIPAL INVESTIGATOR:
Stefan Miska

SENIOR ASSOCIATE DIRECTOR:
Nicholas Takach

ASSOCIATE DIRECTORS:
Mengjiao Yu
Evren Ozbayoglu

RESEARCH ASSOCIATE:
Reza Ettehadi Osgouei

PROJECT ASSISTANT:
Paula Udwin

PROJECT TECHNICIAN:
Randy Darden
Chad Murphy

RESEARCH CONSULTANTS:

Charles Alworth	JJ Azar
Jeremy Daily	Siamack Shirazi
Jim Sorem	Steven Tipton

RESEARCH ASSISTANTS:

Yahya Adariani, Ph.D. Candidate	Babak Akbari, Ph.D. Student
Ziad Alabdullatif, Ph.D. Student	Yuanhang Chen, Ph.D. Student
Vahid Dokhani, Ph.D. Student	Sukru Durmaz, M.S. Candidate
Oney Erge, M.S. Candidate	Lu Huang, Ph.D. Candidate
Ali Karimivajargah, Ph.D. Candidate	Bahri Kutlu , M.S. Candidate
Mehran Mehrabi, M.S. Candidate	Duc Nguyen, Ph.D. Candidate
Mojtaba Pordel Shahri, Ph.D. Student	Gilang Priambodo, M.S. Candidate
Zhaorui Shi, M.S. Candidate	Zhaoyang Wang , M.S. Candidate
Hao Zeng, M.S. Candidate	Feifei Zhang, Ph.D. Student

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Executive Summaries

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Babak Akbari
PDC Drillbit Modeling and Experiments

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Bahri Kutlu
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Experimental Study and Modeling of Barite Sag in Annular Flow

FINAL REPORT

Dissertation to be on website soon

Yahya Hashemian

Experimental Study and Modeling of Barite Sag in Annular Flow

INVESTIGATOR: Yahya Hashemian, TUDRP

PROBLEM STATEMENT:

Barite Sag is the settling of barite particles (or other weighting materials) in the wellbore, which results in undesirable fluctuations in drilling fluid density. A variety of major drilling problems including lost circulation, well control difficulties, poor cement jobs and stuck pipe can result from uncontrolled barite sag. Study of this phenomenon and how to mitigate its effects is the purpose of this work.

OBJECTIVE:

- Mathematical modeling and experimental study of barite sag in annular flow considering effects of annular velocity, eccentricity, pipe rotation and inclination angle on barite sag.

SCOPE OF WORK:

- Modeling: Velocity profile of laminar flow for a non-Newtonian fluid in eccentric annulus with stationary inner pipe was obtained numerically. The calculated velocity was assigned to solid particles in axial. Falling velocity was assigned to each particle from the experimental correlations available in the literature. Having two components of velocity, the time needed for particles to settle at the bottom of the casing was obtained and a corresponding new density was calculated after that time period.
- Experimental study: A large indoor flow loop was modified to conduct flow tests on an oil base mud in annulus. Flow rate, inner pipe rotation, eccentricity and inclination angle is varied to investigate their effects on change of the flowing fluid density.

RECENT PROGRESS:

- Mathematical modeling of barite sag for inclined flow loop
- Mathematical modeling of barite sag for inclined wellbore

DELIVERABLES

- Semi-annual advisory board meeting Progress Reports
- Experimental data set
- Modeling
- Final Report

TIME TABLE:

Task	2009	2010			2011			2012		
	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Literature Review	×	×	×	×	×	×				
Modeling		×	×	×	×	×	×	×	×	
Experiments		×	×	×	×	×	×	×		
Final Report								×	×	

Investigation of Cuttings Transport in 30-60 Degree Inclined Wells

Feifei Zhang

Investigation of Cuttings Transport in 30~60 Degree Inclined Wells

Investigator: Feifei Zhang, TUDRP

Problem Statement:

- The solid concentration in wellbore need to be estimated and controlled accurately during drilling process to keep high ROP and avoid drilling problems like drill pipe stuck, lost circulation.
- Cuttings in the wellbore may have important effects on the bottom hole pressure. To better control bottom hole pressure, cuttings behavior in wellbore must be studied clearly.
- Before tripping out, the wellbore must be cleaned efficiently. To estimate the minimum circulation time to clean the wellbore, cuttings behavior in unsteady state need to be investigated.

Objectives:

- Conduct a series of cuttings transport experiments with different drilling fluids to study cuttings behavior at different operational parameters.
- Develop models to predict flow pattern, change of cuttings concentration and pressure drop with changes of given drilling parameters.
- Study cuttings transient behavior, develop models to predict the minimum circulation time to clean the wellbore at different operational parameters. Optimize the operational parameters to get the well cleaned most economically.

Steady Cuttings Behavior---Drilling Process:

Based on experimental observation, four solid-liquid flow patterns were proposed: constant bed flow, waved bed flow, packed dune flow and dispersed dune flow. From experimental data, a solid-liquid, two-phase flow pattern map is developed. Different mechanistic models are developed for each flow pattern to predict cuttings behavior and pressure gradient in the wellbore.

Transient Cuttings Behavior---Circulation Before Tripping:

- Circulation before tripping may include three situations: 1. the flushing flow rate is large than the drilling flow rate; 2. the flushing flow rate equals the drilling flow rate; 3. the flushing flow rate is smaller than the drilling flow rate.
- The cuttings flushing rate decreases dramatically with time during circulation. The less cuttings left in the wellbore, the more difficult it is to clean it.
- A pressure surge may occur during circulation if the flushing flow rate is larger than the drilling flow rate. The pressure surge needs to be controlled within a safe range to avoid fracturing the formation.

Project Status:

Tasks	2012			2013						2014			
	8	10	12	2	4	6	8	10	12	2	4	6	
Literature Review	×	×	×										40%
Facility Rebuilding	×	×	×										100%
Modeling	×	×	×										20%
Experiment	×	×	×										40%
Data Analysis	×	×	×										20%
Final Report													80%

Pressure Signature of Gas Influx

Ali Karimivajargah

Pressure Signature of Gas Influx

Investigator: Ali Karimi

Sponsor: TUDRP

Problem statement:

Managed Pressure Drilling (MPD) techniques are used with relying on precisely controlling annular pressure profile in the wellbore and hence enabling us to drill in narrow mud window (between pore and fracture pressure). Real time pressure data can be provided by mounting pressure sensors on wired drillpipe. By having access to such data at several locations along the wellbore, variations of annular pressure profile during entrance of gas influx can be utilized for early gas detection and determining its location. Therefore, developing a simulator for accurate prediction of the annular pressure profile during gas influx is desired. In addition to early gas detection, this powerful tool can be used for designing and decision-making processes for MPD well control operations. Other outcomes of this modeling work include: enhancing safety in drilling, reducing drilling costs by reducing non-productive time and improving MPD well control operations.

Objectives

Developing a gas influx simulator for:

- Early detection of gas influx and its location in the wellbore by mounting the pressure sensors on Wired Drill String during MPD and conventional operations
- Predicting variations in the annular pressure profile during gas influx to the wellbore, before and after shut-in and when drilling is stopped (pumps are off)
- Providing a design and a decision-making tool for MPD well control operations
- Predicting pressure profiles (pressure vs. time) at desired locations such as casing shoe
- Predicting gas and liquid fractions along the wellbore, gas migration velocity, solubility of gas in OBM and SBM, pit gain vs. time, and gas and liquid velocity distribution in the annular space
- Validating the model by experimental and field data

Current Work

- Extending the model to synthetic and oil-based mud (mass transfer exists) and proposing a general solution procedure
- Modifying the slip model for deviated wells
- Comparing the available experimental data at TUDRP with simulation results for nearly vertical (15^o) air-water, two-phase flow, with and without drillpipe rotation to validate the model
- Performing sensitivity analysis to investigate effects of important parameters and comparing results of SBM with WBM
- Validating the accuracy of pressure sensors by using pressure field data from Wired Drillpipe (provided by BP)

Deliverables

- A transient two-phase simulator for predicting pressure profile during gas influx, proposing methods for early gas detection and determining its location, volume, and movement in the wellbore by mounting pressure sensors on WDP
- A design and decision-making tool for MPD well control operations to find the best response to a gas influx
- Matching the model with experimental and field data obtained from Wired Drill String Technology
- Semi-annual Advisory Board Meeting (ABM) reports and the Final Report

Project Status and Proposed Time Table

Work Time / Deliverables	2010			2011			2012			2013	Project Status
	1-4	5-8	9-12	1-4	5-8	9-12	1-4	5-8	9-12	1-5	
Literature Review											90%
Mathematical Modeling											80%
Computer Simulations											70%
Field Data Analysis											30%
Final Report											0%

PDC Drillbit Modeling and Experiments

Babak Akbari

PDC Drill Bit Modeling and Experiments

Investigator: Babak Akbari

Sposnosr: TUDRP

Objectives:

- To conduct single PDC cutting tests for controlling the pore pressure (thereby, the differential pressure).
- To conduct single PDC cutting tests with different sizes of cutters.
- To develop a single PDC cutter mechanistic model in 3D that is based on theory and experimental results.
- The model will take into account details such as chamfer, and back and side rake angles. The goal is to provide output with more details, such as resultant cutting vibrations.
- To develop a Distinct Element Model for rock cutting (tentative).

Current Work

- Modified our single-cutter facility to allow control of pore pressure during experiments.
- Conducted the first set of experiments holding the pore pressure constant and changing the confining pressure.
- Conducted the second set of experiments, in which cell pressure and confining pressure are kept equal (zero differential pressure) at pressures ranging from atmospheric to 450 psi.
- Developed a single PDC cutting model in 2D considering the existing chamfer geometry and more complicated geometries.
- Analyzed TUDRP single cutter database to detect oscillation behavior of the force signal and relate that to the rock and operational parameters.

Future Work and Deliverables

- Conduct more experiments to confirm the results obtained for differential pressure tests.
- Develop the current 2D model to a 3D chamfer cutter model.
- Investigate the detected oscillations and potentially use a DEM to reproduce them.
- Conduct experiments with different sized cutters.
- Characterize the rocks that have been tested to determine their hardness, UCS, friction angle and other parameters.

Project Status

Time / Task	**2011 9-12**	**2012 1-6**	**2012 7-12**	**2013 1-6**	**2013 7-12**	**2014 1-6**
Literature Review						
Pore Pressure Experiment						
Mechanistic and DEM Modeling						
Cutter Size -- Experiments						
Final Analysis/conclusion						
Final Report						

Effect of Free Drillstring Rotation on Frictional Pressure Losses

Oney Erge

Effect of Free Drillstring Rotation on Frictional Pressure Losses

INVESTIGATOR: Oney Erge, TUDRP

INTRODUCTION:

Keeping mud equivalent circulating density in the operating window between the pore and fracture pressure is a challenge. To overcome this challenge, accurate estimation of frictional pressure loss in the annulus is essential, especially for extended reach and slim hole drilling applications usually encountered in shale gas and/or oil drilling. A better estimation of frictional pressure losses will provide improved well control, optimized bit hydraulics, a better drilling fluid program and pump selection. Field and experimental measurements showed that, pressure loss in the annulus is strongly affected by the pipe rotation and the eccentricity. In wellbore, drillstring rotates freely and as drillstring rotates, eccentricity is varying. There is a substantial need for a reliable model that accurately estimates the effect of free drillstring rotation on frictional pressure losses.

OBJECTIVES:

- To develop a mathematical model for the flow of Yield Power Law (YPL) fluids in annuli including the effect of free drillstring rotation
- To develop a better understanding for the transition from laminar to turbulent region in annular geometries
- To conduct experiments using Yield Power Law fluids in an annular geometry including a freely rotating drillstring

SCOPE OF WORK:

- Effect of a freely rotating drillstring will be investigated both theoretically and experimentally. The major focus of this project is on a horizontal well setup with drillstring under compression, considering the influence of rotation on frictional pressure losses of YPL fluids.
- A model for a cross section with a unit length of a drillstring will be developed and it will be extended throughout the wellbore to account for the total annular frictional pressure loss in a wellbore.
- New friction factors definitions including the pipe buckling mode and pipe rotation speed for laminar, transition and turbulent flow regimes will be developed.

RECENT PROGRESS:

- TUDRP's Outside Dynamic Testing Facility modifications are finalized.
- Water tests are completed & a low yield low viscosity YPL fluid is tested. For water and a YPL fluid, the tests are conducted for varying flow rate, different rotation speeds, compression loads and buckling configurations. Investigation for the very high Reynolds number fluids are finalized.

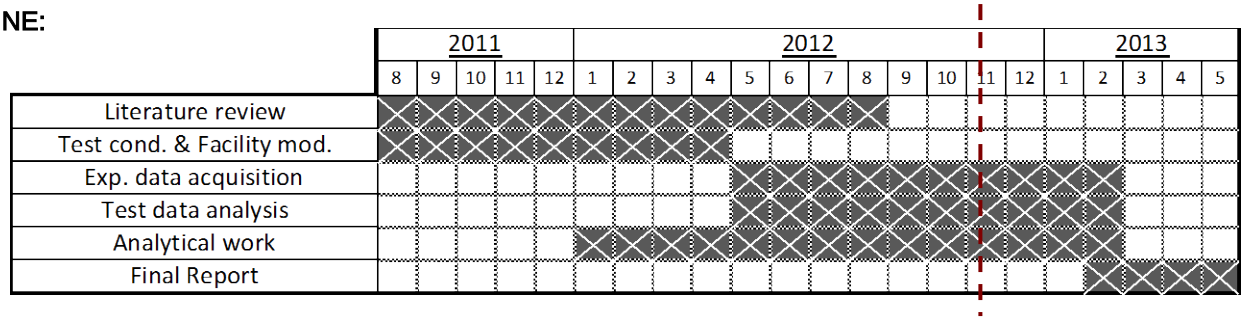
FUTURE WORK:

- Development of the mathematical model.
- Testing of various YPL fluids. YPL fluids with high yield stress and more viscous fluid tests are planned. Laminar, transition and early turbulent regimes will be investigated. 4 additional different YPL fluid database are aimed to be constructed.

DELIVERABLES:

- A mathematical model that accounts for free drillstring rotation effects on the annular frictional pressure losses
- Experimental database for annular flow of Yield Power Law fluids, including the effect of pipe rotation
- Semi-annual Advisory Board Meeting Progress Reports & A Final Report

TIMELINE:



Stress Path Analysis in Depleted Sands

Mojtaba Pordel Shahri

EXECUTIVE SUMMARY

Stress Path Analysis in Depleted Sands

Investigator: Mojtaba Pordel Shahri, TUDRP

Problem Statement:

Without detailed knowledge of reservoir stress path, i.e., change in fracture gradient with pore pressure, geomechanical modeling of depleted reservoirs is less quantitative and problems such as lost circulation, sand control and wellbore instability become more severe in existing and new wells. The ability to design wells with the lowest non-productive time (NPT) relies on greater accuracy in predicting stress changes likely to occur in reservoirs that have undergone partial depletion.

Objectives:

- To develop an understanding of the theory of poroelasticity and reservoir stress path in partially depleted sands
- To develop a new model for predicting reservoir stress path during production/injection in partially depleted reservoirs
- To develop a computer simulator to predict the reservoir stress path
- To verify the model with field data (laboratory data will be used to determine the geomechanical deformation model's parameters)

Current Works:

- A Modified Inversion technique is proposed to predict reservoir stress field using fracturing data. By means of the proposed technique, the minimum and maximum horizontal stresses corresponding to different pore pressures can be determined. This is known as reservoir stress path or stress depletion ratio.
- An experimental procedure is proposed to simulate depletion/injection scenarios during the reservoir life. Three Berea samples will be used to investigate the depletion/injection responses of a reservoir. Using the standard procedure, Young modulus and Poisson's ratio are measured for all rock samples.
- The completed Beltrami – Michell compatibility equations in a fully-saturated, poroelastic medium are formulated in cylindrical coordinates. These coupled partial differential equations will be used for solving a coupled fluid flow-geomechanical model.

Deliverables:

- A new mathematical model for predicting reservoir stress path
- Computer simulator for predicting reservoir stress path
- Matching the new model with field data
- Semi-annual Advisory Board Meeting (ABM) reports and the Final Report
- PhD dissertation

Current Project Status:

Time / Work	2011	2012			2013			2014	
	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer
Literature Review									
Mathematical Modeling									
Computer Simulation									
Experimental & Field Data Analysis									
Final Report									

Automatic Control of Drawworks

Zhaoyang Wang

EXECUTIVE SUMMARY

Automatic Control of Drawworks

Investigator: Zhaoyang Wang, TUDRP

Problem Statement:

Automation in the drilling industry has been at a relatively low level compared to other industries, however, research and development on automation solutions within the drilling community has increased significantly during the last decade. Tripping procedure is one of the main parts of a drilling process. With increasing complex wellbore geometries and narrow geo-pressure windows, it is not easy for the driver to accurately estimate the real maneuvering limits of the drawworks during tripping, especially under poor downhole conditions. Thus, an optimization tripping model is needed to obtain the minimum tripping time while maintaining the wellbore pressure, strength of drillpipe and drawworks in good condition.

Theretical Work:

The dynamic pressure surge model (Lubinski and Mitchell) and dynamic loading of drillpipe model (Lubinski) have been reviewed. Lubinski's dynamic loading on drillpipe model and dynamic downhole pressure surge model have been rebuilt. This has allowed dynamic downhole pressure surge and dynamic loading on drillpipe phenomena to be simulated. Based on the theoretical work, an optimization model of tripping has been developed. Meaningful results are given.

Recent Progress:

A mathematical optimization model has been developed. Through this model, a minimum tripping time can be obtained while maintain wellbore pressure within the pressure window and keeping the drillpipe in good condition. This model can guide the driller to choose tripping velocity in real time. Through a "real world" case study, we can guide the driller to choose the velocity for drillpipe at different depths of wellbore. For different depths, we use different velocity profiles. Thus, the total tripping procedure has been optimized. Also, Lubinski's model of dynamic loading on drillpipe and dynamic downhole pressure surge model have been rebuilt.

Future Work:

For the optimization of tripping program, a better algorithm should be developed to achieve optimized tripping velocity profile for the whole tripping in and out procedure. Also, the wellbore can be divided into more sections, thus the tripping velocity profile can be obtained for tripping each stand of drillpipe. Furthermore, since the tripping velocity profile we choose is the most commonly used one at this time, we can try different shapes of velocity profiles in the future. In the end, we can even improve the optimization program by improving the dynamic downhole pressure model and loading of drillpipe model.

Project Status:

Activity/Time	Fall 2011	Spring 2012	Summer 2012	Fall 2012	Spring 2013	Status
Literature Review	×	×	×	×		80%
Modeling		×	×	×		70%
Analysis of the results		×	×	×		65%
Final Report						0%

Rheology of Lightweight Drilling Fluids with Microsphere Additives

Bahri Kutlu

Rheology of Lightweight Drilling Fluids with Microsphere Additives

Investigator: Bahri Kutlu, TUDRP

Introduction & Statement of Problem

Redeveloping old fields which are in a partially depleted stage and drilling and completion of horizontal wells with open holes in low pressure deposits have led to the investigation of new types of lightweight drilling fluids. The goal of this project is to develop drilling fluids having densities less than those of base fluids without using air or other compressible gases. The primary objective is to develop drilling fluids to reduce wellbore pressure and ECD by means of using lightweight solid additives.

Objectives

- Evaluating incompressible drilling fluids having densities less than that of base fluids by including lightweight hollow spheres.
- Conducting a study on rheological properties and flow characteristics of lightweight drilling fluids that include lightweight hollow spheres.

Scope of Work

Experiments are categorized in two groups: Rheology tests and fluid characterization tests. Rheology tests are being conducted with a Fann75 HPHT viscometer. Tests will be run at a range of different temperatures and pressures up to 18000 psi to determine the rheological behavior of drilling fluids containing lightweight solid additives. Fluid characterization tests will be conducted using a flow loop with three different diameter pipe sections and pipes with both rough and smooth surfaces to investigate the effects of roughness turbulent flow of drilling fluids mixed with hollow glass microspheres.

Summary & Conclusions

Between November 2011 and May 2012, a literature review on the use of hollow glass microspheres in the oil and gas industry was begun. After deciding on the experimental setup, a series of preliminary tests were conducted with a Fann 75 HPHT viscometer at pressures up to 18000 psi and temperatures up to 150 F. Experiments are also planned at 200 F.

- The rheological behavior of the tested drilling fluids containing hollow microspheres is found to be consistent with models available in the literature that estimate suspension viscosity.
- The tested fluids offer the promise of density reduction under ambient temperature and pressure. Also, when the fluids are subjected to pressures up to the highest pressures rated by the manufacturer of the hollow glass spheres, the spheres showed an average survival ratio of 93% with only a 1.26% average increase in specific gravity.

Deliverables

- Rheological characterization using TUDRP's Dynamic Testing Facility of fluids mixed with different concentrations of glass microspheres, including analysis of data gathered in turbulent regime
- Semi-annual Progress Reports and a Final Report

Time Table

	2012	2013		
	11-12	1-2	3-4	5-6
Exp. data acquisition	■	■	■	
Test Data analysis	■	■	■	
Analytical work	■	■	■	
Final report			■	■

Study of Effectiveness of LCM Materials

Hao Zeng

Study of Effectiveness of LCM Materials

Investigator: Hao Zeng, TUDRP

Introduction: Lost circulation is one of the most common well control problems encountered in drilling, cementing and completion operations. It will not only waste time and drilling fluid it can also damage formations, lead to hole collapse and stuck drill pipe, and can even result in blowouts and well abandonment. Large amounts of time and money are spent to control lost circulation. The use of lost circulation materials (LCM) is the most common method to treat problems associated with lost circulation. However, the effectiveness of LCM is poorly understood. As a result, better understanding and maximizing the effectiveness of LCM is important for controlling the costs of lost circulation.

Objectives:

- Provide more thorough understanding of existing PSD selection theories and rheological issues that occur in fractured wellbores.
- To observe LCM behavior in uniform-sized fractures under different flow rates.
- To determine the effectiveness of different LCM materials.
- To develop an optimized LCM selection model.

Current Work:

- Reviewed existing fracture size and pressure models, hydraulic ECD models and LCM selection models.
- Modified TUDRP's Parallel Plate Radial Flow Facility.
- Designed and conducted a series of tests using the modified facility.
- Started to work on verifying existing methods and theories using the experimental data.

Deliverables:

- Advanced LCM effectiveness testing facility.
- Experimental observation and analytical analysis of LCM bridging behavior.
- Optimized LCM selection model.
- Semi-Annual Advisory Board Meeting (ABM) reports and the Final Report.

Project Status

	2011	2012			2013
	Fall	Spring	Summer	Fall	Spring
Literature Review	X	X	X	X	
Experimental Technique Development	X	X	X	X	
Experiments		X	X	X	
Data Analysis		X	X	X	
Modeling					
Final Report				X	

Comparison of Steel, Aluminum, Titanium and Composite Drill Pipe

PROPOSAL

Mehran Mehrabi

EXECUTIVE SUMMARY

Comparison of Steel, Aluminum, Titanium and Composite Drillpipe

Investigator: Mehran Mehrabi, TUDRP

Problem Statement:

The emergence of drill pipes made of materials other than steel needs a thorough study of advantages and disadvantages compared with conventional drill pipes. To the best of the author's knowledge there is no published literature on comparison of four different categories of drillpipes (DP) that considers mechanical aspects in a single study. However, there are some scattered papers on comparison of a specific mechanical aspect in a special drilling scenario for two or three categories of DPs.

Objectives:

The following aspects of drillpipe mechanics are going to be studied.

I. Fatigue performance
II. Buckling
III. Torque and drag loads
IV. Margin of overpull (MOP)

Scope of Work:

In this project the mechanical behavior of four different groups of drillpipes (SDP, ADP, TDP and CDP) will be studied and compared. Specifically, the comparisons will include:

I. Fatigue performance in build-up and drop-off section both under tension and compression in a constant curvature dogleg
II. Buckling behavior in vertical, horizontal and inclined section of a well
III. Torque and drag loads based on soft and stiff drillstring modeling
IV. Margin of overpull

Deliverables:

I. A computer program for investigating and comparing:
    a. Fatigue performance
    b. Buckling
    c. Torque and Drag
II. Drillstring design guidelines (including MOP)
III. Semi-annual Advisory Board Meeting (ABM) and the Final Report
IV. Master Thesis

Proposed Time Table:

Time / Work	2012	2013			2014	
	Fall	Spring	Summer	Fall	Spring	Summer
Literature Review						
Fatigue performance computer program						
Buckling computer program						
Torque and drag load computer program						
Margin of overpull comparison						
Final Report						

Displacement and Mixing of Fluids in Pipe Flow

PROPOSAL

Sukru Durmaz

DISPLACEMENT AND MIXING OF FLUIDS IN PIPE FLOW

INVESTIGATOR: Sukru Durmaz

STATEMENT OF THE PROBLEM:

There are various applications related to displacement of fluids in the petroleum industry. For example, displacement of spots, displacement of sweeps, displacement of spacers, and displacement of cement slurries. Contamination can cause significant changes in both displacing and displaced fluid properties during displacement processes and these changes can lead to various serious problems in many applications. Displacement of fluids is a complicated process since it depends on many parameters, such as density and viscosity of the fluids, conduit geometry, inclination, and flow regime. The primary objective of this project is to analyze the mixing of fluids in displacement processes and to observe the influence of these parameters on the mixing of fluids during displacement processes in pipe flow as a first phase of the study.

OBJECTIVES:

- To develop better understanding of mixing of fluids flowing inside circular pipes and to observe the influence of various parameters (density and viscosity of fluids, pipe dimensions, pipe inclination, flow regime) during the displacement process.
- To develop a mathematical model for describing fluid displacement in circular pipes.
- To obtain high quality experimental data using different fluids and different pipes during the displacement process.
- Analyze the data and determine the influence of various parameters on mixing of fluids in pipe flow during the displacement process.

SCOPE OF WORK:

- Displacement and mixing of fluids flowing inside circular pipes will be investigated both theoretically and experimentally.
- A new experimental setup will be developed for this research, which will be allowing both upward and downward flow through a circular pipe test section. Water-based fluids with different rheological and physical properties, such as high and low viscosities, and high and low densities, will be used as displacing and displaced fluids.
- A mathematical model will be developed for describing the mixing and displacement process of fluids in circular pipes. Comparisons will be made between the developed model and experimental results.

DELIVERABLES:

- Experimental data, including pressure drop and high quality digital images, during displacement tests with various fluids
- Mathematical model describing the displacement process
- Semi-annual ABM Progress Reports and a Final Report

PRELIMINARY TIMELINE:

	2012					2013												2014					
	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
Literature Review																							
Facility Design																							
Ex. Data acquisition																							
Test data analysis																							
Mathematical model																							
Final Report																							

Annular Pressure Build Up (APB) Analysis-Optimization of Fluid Rheology

PROPOSAL

Reza Ettehadi Osgouei

EXECUTIVE SUMMARY

Annular Pressure Build Up (APB) Analysis- Optimization of Fluid Rheology

Investigators: Dr. Reza Ettehadi Osgouei, The University of Tulsa, Drilling Research Projects

Introduction:

Higher geothermal gradients in deeper sections of a wellbore elevate the temperature of casings and annular fluids at the bottom of the annular space in the wellbore. Consequently, a temperature gradient between the surface and the bottom of annular space functions as the driving force for convective heat transfer during production. This will lead to secondary fluid flow within the annulus.

Objectives:

- To develop a better insight of convective heat transfer in the annulus of casing
- To model the convective heat transfer of Yield Power Law fluids across vertical parallel plates and to predict long time behavior of annular fluids
- To design experimental set up and to obtain high quality experimental data using different fluids
- To provide design guidelines for selection of proper annular fluids for deep-water oil and gas wells to minimize the rate of heat transfer from the flowing production fluid

Scope of Work:

The proposed project includes both modeling and experimental work to understand convective heat transfer along the annulus. This work can be done in three stages: 1. Build a mathematical model of convective heat transfer; 2. Conduct experiments to obtain pressure and temperature distribution along an annulus; 3. Compare experimental results to the mathematical model.

Deliverables:

- Experimental data, including pressure drop and temperature distribution, during APB (annular pressure buildup) tests with various fluids
- Mathematical model describing the convective heat transfer of Yield Power Law fluids
- Semi-Annual ABM Progress Reports and a Final Report
- Computer program

Tentative Time Table: